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EXAMINER

KAO, CHIH CHENG G

ART UNIT	PAPER NUMBER
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2882

DATE MAILED: 03/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/731,671

Applicant(s)

NAHUM ET AL.

Examiner

Chih-Cheng Glen Kao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 June 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-58 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 41-43 is/are allowed.
- 6) ☒ Claim(s) 1-8, 11, 13, 15-40 and 44-58 is/are rejected.
- 7) ☒ Claim(s) 9, 10, 12 and 14 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 April 2002 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 4.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

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DETAILED ACTION

Election/Restrictions

1. The restriction in the office action made of record on 3/26/03 has been withdrawn.

Information Disclosure Statement

2. The information disclosure statement filed 2/14/01 fails to comply with 37 CFR 1.98(a)(2), which requires a legible copy of each U.S. and foreign patent; each publication or that portion which caused it to be listed; and all other information or that portion which caused it to be listed. It has been placed in the application file, but the information referred to therein has not been considered. The missing copy is Yamaguchi et al. ("Linear and Rotary Encoders Using Electronic Speckle Correlation").

Drawings

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: (page 10, lines 20-21, "readhead assembly 106") and (page 15, line 26, "correlation function value points 201"). Corrected replacement drawings or amendment to the specification are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

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4. The drawings are objected to because Figure 17, #162 is mislabeled. This objection may be obviated by replacing 162 with 164. Corrected replacement drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

5. The abstract of the disclosure is objected to because the abstract may not exceed 150 words in length. Correction is required. See MPEP § 608.01(b).

6. The disclosure is objected to because of the following informalities: (page 42, line 6, “a point 904”) and (page 42, line 9, “the point 905”). This objection may be obviated by exchanging references numerals 904 and 905 with each other. Appropriate correction is required.

Claim Objections

7. Claims 1, 7, 8, 10, 15, 16, 22, 24, 30, 33, 34, 40, 41, 50, 51, 54, and 55 are objected to because of the following informalities, which appear to be minor draft errors creating grammatical or lack of antecedent basis problems.

In the following format (location of objection; respective suggestion), the following suggestions may obviate the objections: (claim 1, line 5, “the asymmetry”; deleting “the”), (claim 7, lines 8-9, “the predictable systematic estimation errors”; deleting “the”), (claim 8, line 4, “the correlation function”; inserting - of a correlation function- - in claim 1, line 4, after

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“correlation function value points”), (claim 8, line 5, “extremum, and a second”; deleting the comma), (claim 10, line 5, “end point”, replacing “end point” with - -endpoint- -), (claim 10, line 9, “end point”; replacing “end point” with - -endpoint- -), (claim 15, line 9, “the second side”; replacing “the” with - -a- -), (claim 16, lines 1-2, “the characterization”; deleting “for the at least one line segment” and inserting - -of the at least one line segment- - after “characterization”), (claim 22, second to last line, “the vicinity”; replacing “the” with - -a- -), (claim 22, second to last line, “the correlation function”; inserting - -of a correlation function- - into line 4 after “correlation function value points”), (claim 24, line 2, “the correlation function curve”; replacing “the” with - -a- -), (claim 30, line 4, “the asymmetry”; deleting “the”), (claim 30, line 7, “the predictable systematic estimation errors”; deleting “the”), (claim 33, lines 8-9, “the spatial translation”; deleting “the”), (claim 33, line 13, “light detector interface circuitry”; replacing “circuitry” with - -circuit- -), (claim 33, line 20, “the relative position”, replacing “the” with - -a- -), (claim 33, line 22, “the light detector interface circuitry”; replacing “circuitry” with - -circuit- -), (claim 33, second to last line, “the vicinity”; replacing “the” with - -a- -), (claim 33, second to last line, “the correlation function”; inserting - -of a correlation function- - into line 35 after “correlation function value points”), (claim 34, line 3, “read head”; replacing “read head” with - -readhead- -), (claim 40, line 10, “the characterization”; deleting “the”), (claim 40, line 10, “the estimated point, and at”; deleting the comma), (claim 41, line 4, “the light”; deleting “the”), (claim 41, line 16, “interface circuitry”; replacing “circuitry” with - -circuit- -), (claim 41, line 21, “the image”; inserting - -first- - before “image”), (claim 41, line 28-29, “a set of correlation function value”; inserting - -points- - after “value”), (claim 41, line 33, “the ratio”, replacing “the” with - -a- -), (claim 41, line 33, “the peak-to-peak systematic error”; deleting “the”), (claim

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50, line 8, "the displacement", deleting "the"), (claim 50, last line, "the vicinity"; replacing "the" with - a - -), (claim 50, last line, "the correlation function"; inserting - of a correlation function- - into line 7 after "correlation function value points"), (claim 51, line 10, "the displacement"; deleting "the"), (claim 51, last line, "the vicinity"; replacing "the" with - a - -), (claim 51, last line, "the correlation function"; inserting - of a correlation function- - into line 7 after "correlation function value points"), (claim 54, line 12, "the displacement"; deleting "the"), (claim 54, last line, "the vicinity"; replacing "the" with - a - -), (claim 54, last line, "the correlation function"; inserting - of a correlation function- - into line 4 after "correlation function value points"), and (claim 55, lines 2-3, "the correlation function curve"; replacing "the" with - a - -).

For purposes of examination, the claims have been treated as such. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 8, 11, 13, 15, 18, 27, and 40 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

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9. Regarding claims 8, 11, and 13, the phrase "presumably" renders the claim indefinite because it is unclear whether the limitation(s) following the phrase are part of the claimed invention.

For purposes of examination, the phrase "presumably lying on the correlation function" in lines 4 and 5-6 of claim 8, lines 4 and 7 of claim 11, and lines 1-2 of claim 13 has not been accorded any patentable weight.

10. Regarding claim 15, the phrase "presumably" renders the claim indefinite because it is unclear whether the limitation(s) following the phrase are part of the claimed invention.

For purposes of examination, the phrase "presumably corresponding to the correlation function" in lines 3-4 of claim 15 has not been accorded any patentable weight.

11. Regarding claim 18, it is indefinite as to how the prescribed form can correspond to a straight line when it corresponds to a line of constant curvature as well as recited in claim 17. A line of constant curvature cannot be a straight line.

For purposes of examination, claim 18 has been treated to depend on claim 16 instead of claim 17. Appropriate correction is required.

12. Regarding claim 27, the phrase "presumed" renders the claim indefinite because it is unclear whether the limitation(s) following the phrase are part of the claimed invention.

For purposes of examination, the phrase "presumed" in the second to last line of claim 27 has not been accorded any patentable weight.

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13. Regarding claim 40, the phrase "presumed" renders the claim indefinite because it is unclear whether the limitation(s) following the phrase are part of the claimed invention.

For purposes of examination, the phrase "presumed to lie on the correlation function" in lines 3-4 of claim 40 has not been accorded any patentable weight.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

14. Claims 1-5, 15, 16, 18-29, 44, 46, 47, 50, and 52-56 are rejected under 35 U.S.C. 102(b) as being anticipated by Hirooka et al. (Translation of JP 09-129770).

15. With regards to claims 1, 44, 46, and 52, Hirooka et al. discloses a method, system, device, and program comprising determining a set of correlation function value points indicative of a correlation function extremum, each value point based at least partially on a pattern of image values in the first and second image, each value point further based on a respective known spatial translation of the image values in the second image relative to the first image (Drawing 19), and estimating at least one spatial translation position corresponding to at least one symmetry point which is not the extremum, based on a plurality of value points bounding the extremum, the at

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least one spatial translation positions corresponding to the at least one symmetry point indicative of displacement of the second image relative to the first image (Drawing 19, estimated location).

16. With regards to claims 22, 50, and 54, Hirooka et al. discloses a method, device, and program comprising determining a set of correlation function value points indicative of a correlation function extremum, each value point based at least partially on a pattern of image values in the first and second image from a sensing device (Drawing 1, #14), each value point further based on a respective known spatial translation of the image values in the second image relative to the first image (Drawing 19), and estimating at least one spatial translation position based on a plurality of value points bounding the extremum, the at least one spatial translation position indicative of displacement of the second image relative to the first image (Drawing 19, estimated location), wherein estimating does not depend on characterizing in the vicinity of the extremum (Drawing 19, s_{minus1} and s_0).

17. With regards to claims 2 and 53, Hirooka et al. further discloses excluding at least one value point at a spatial offset bounded by other members of the value points (Drawing 19, s_{plus2}).

18. With regards to claims 3-5 and 23, Hirooka et al. further discloses the excluded value point within a prescribed range of spatial offsets and values, which may be nearest to the correlation function extremum (Drawing 19, s_{plus2}).

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19. With regards to claims 15, 16, 18, and 19, Hirooka et al. further discloses determining a characterization of a straight line segment on a first side of the correlation function extremum (Drawing 19, line through s_0 and s_{+1}) and estimating the spatial translation position based at least partially on the characterization of the at least one line segment and at least one characteristic of at least one correlation function value point on a second side of the correlation function extremum (Drawing 19, s_{-1}), wherein the prescribed form is based on characteristics of a predetermined correlation function from first and second images (paragraphs [0091] and [0092]).

20. With regards to claims 20 and 21, Hirooka et al. further discloses determining at least one characteristic of at least one first-side line segment based on at least two first-side correlation function value points on a first side of the correlation function extremum (Drawing 19, s_0 and s_{+1}), determining at least one characteristic of at least one second-side line segment based on at least two second-side correlation function value points on a second side of the correlation function extremum (Drawing 19, s_{-1} and s_{-2}), and estimating a spatial translation position based on slopes of the line segments (Drawing 19, estimated location).

21. With regards to claims 24, 55, and 56, Hirooka et al. further discloses estimating a curve over at least one range outside the vicinity of the extremum and estimating the spatial translation position based on at least one characteristic of a presumed line of symmetry which is not local to the vicinity of the extremum (Drawing 19, curve from s_0 to s_{+1}).

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22. With regards to claim 25, Hirooka et al. further discloses estimating a curve over at least one range encompassing values in the vicinity of the extremum (Drawing 19, line through s0).

23. With regards to claim 26, Hirooka et al. further discloses determining a characteristic not local to the vicinity of the extremum (Drawing 19, line through s0).

24. With regards to claim 27, Hirooka et al. further discloses excluding at least one correlation function value point (Drawing 19, s_plus2), and the characteristic which is not local of the extremum is the location of a presumed line of symmetry (Drawing 19, line through s0).

25. With regards to claims 28 and 29, Hirooka et al. further discloses less than 6 correlation value points (Drawing 19, s0, s_plus1, s_minus1, and s_minus2).

26. With regards to claim 47, Hirooka et al. further discloses means for acquiring first and second images (Drawing 1, #41).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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27. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirooka et al. as recited in claim 1 above, and further in view of Hirzel et al. (US Patent 4671650).

Hirooka et al. discloses a device as recited above.

However, Hirooka et al. does not disclose summing absolute values of differences between paired image values for a set of paired image values.

Hirzel et al. teaches summing absolute values of differences between paired image values for a set of paired image values (Fig. 7c, "SUM ABS. VALUE OF DIFFERENCES").

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to have the device of Hirooka et al. with the summing of absolute values of differences of Hirzel et al., since one would be motivated to incorporate this for faster correlation processing (col. 13, lines 60-69) as shown by Hirzel et al.

28. Claim 7, 17, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirooka et al. as recited in claims 1, 16, and 22 above, and further in view of Schreier et al. (Systematic errors in digital image correlation caused by intensity interpolation).

29. Regarding claims 7 and 30, Hirooka et al. discloses a device and method as recited above. Hirooka et al. further discloses estimating a first estimate, which would necessarily include predictable systematic estimation errors related to asymmetry of correlation function value points.

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However, Hirooka et al. does not disclose adjusting a first estimate based at least partially on systematic estimation errors, to at least partially reject systematic estimation errors related to asymmetry of correlation function value points about the correlation function extremum.

Schreier et al. teaches adjusting a first estimate based at least partially on systematic estimation errors, to at least partially reject systematic estimation errors related to asymmetry of correlation function value points about the correlation function extremum (page 2918, col. 1).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to have the device and method of Hirooka et al. with adjusting a first estimate of Schreier et al., since one would be motivated to incorporate this to reduce errors (page 2918, col. 1) as shown by Schreier et al.

30. Regarding claim 17, Hirooka et al. discloses a device as recited above.

However, Hirooka et al. does not disclose a line of constant curvature.

Schreier et al. teaches a line of constant curvature (page 2920, col. 1, 3rd paragraph, last sentence).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to have the device of Hirooka et al. with the line of constant curvature of Schreier et al., since one would be motivated to incorporate this faster processing (page 2920, col. 1, 3rd paragraph, last sentence) as implied from Schreier et al.

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31. Claims 31-40, 45, 48, 49, 51, 57, and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirooka et al. as recited in claims 22, 44, 46, and 54 above, and further in view of Tullis (US Patent 5686720).

32. Regarding claim 33, Hirooka et al. discloses a device comprising a sensing device (Drawing 1, #41), a light detector circuit interface (Drawing 1, #42), and a device which would necessarily have a signal generating and processing circuitry, wherein light creates an intensity pattern (Drawing 1, #40 and 41), the light detector interface circuit outputs an image signal (Drawing 1, #42), the signal generating and processing circuitry element inputs a first and second image (Drawing 1, #43), determines a set of correlation function value points (Drawing 19), and estimates a spatial translation position (Drawing 19, estimated location), wherein the spatial translation position does not depend on characterizing in a vicinity of the extremum (Drawing 19, s_0 and $s_{\text{minus}1}$).

However, Hirooka et al. does not specifically disclose a plurality of image elements.

Tullis teaches a plurality of image elements (Abstract, lines 5-7).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to modify the device of Hirooka et al. with the image elements of Tullis, since one would be motivated to incorporate this for higher-speed acquisition of position encoding (col. 1, lines 15-17) of an image greater than one pixel (Fig. 11) as implied from Tullis.

33. Regarding claim 34, Hirooka et al. further discloses relative displacement along at least one axis (Drawing 19, location in x or y).

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34. Regarding claims 31, 32, 35, 45, 48, 51, and 58, Hirooka et al. discloses a device as recited above.

However, Hirooka et al. does not disclose displacement of speckle images indicative of movement of a surface relative to the sensing device via coherent light.

Jackson teaches displacement of speckle images indicative of movement of a surface relative to the sensing device via coherent light (col. 1, lines 15-17, and col. 12, lines 65-67).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to modify the device of Hirooka et al. with the speckle image displacement of Tullis, since one would be motivated to incorporate this for higher-speed acquisition of position encoding (col. 1, lines 15-17) as implied from Tullis.

35. Regarding claim 36, Hirooka et al. further discloses a processor (Drawing 15, #53-58), which would necessarily have a program.

36. Regarding claims 37 and 38, Hirooka et al. would necessarily have an interpolation circuit with a correlation function value point identification circuit, an estimated coordinate identification circuit, and an estimated peak offset value determining circuit (Drawing 19).

37. Regarding claim 39, Hirooka et al. further discloses selecting a plurality of correlation function value points (Drawing 19, s₀, s_{plus1}, s_{minus1}, s_{minus2}) along with characterizing

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and estimating at least the spatial translation position value which is not one of the selected correlation function value points (Drawing 19, estimated location).

38. Regarding claim 40, Hirooka et al. further discloses at least one point comprising an estimated point on an opposite side of the extremum from a correlation function value point (Drawing 19, point opposite s_minus1) and estimating the spatial translation position (Drawing 19, estimated location) based on characterization to the estimated point (Drawing 19, point opposite s_minus1) and at least the spatial translation of the correlation value point (Drawing 19, s_minus1).

39. Regarding claim 49, Hirooka et al. further discloses means for acquiring first and second images (Drawing 1, #41).

Allowable Subject Matter

40. Claims 41-43 contain allowable subject matter.

41. Claims 8-14 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and all intervening claims.

42. The following is a statement of reasons for the indication of allowable subject matter.

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With regards to claim 8, prior art does not disclose or fairly suggest a method for estimating a displacement of a second image acquired by a sensing device relative to a first image acquired by the sensing device including the step of determining the midpoint of at least one line segment having a first endpoint on a first side of the correlation function extremum and a second endpoint on a second side of the correlation function extremum, in combination with all the limitations in the claim and base claim. Claims 9 and 10 contain allowable subject matter by virtue of their dependency.

With regards to claim 11, prior art does not disclose or fairly suggest a method for estimating a displacement of a second image acquired by a sensing device relative to a first image acquired by the sensing device including the step of determining a spatial translation position value which is midway between a first and second spatial translation position, in combination with all the limitations in the claim and base claim. Claims 12-14 contain allowable subject matter by virtue of their dependency.

With regards to claim 41, prior art does not disclose or fairly suggest a speckle-image-correlation position transducer readhead wherein a ratio of peak-to-peak systematic error which repeats at a period corresponding to one image element pitch to the number of correlation function value points in a set used to determine a spatial translation position is not more than about .02 parts of the image element pitch per correlation function value point, when the peak-to-peak systematic error is expressed as a fraction of the image element pitch, in combination with all the limitations in the claim. Claims 42 and 43 contain allowable subject matter by virtue of their dependency.

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Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chih-Cheng Glen Kao whose telephone number is (571) 272-2492. The examiner can normally be reached on M - F (9 am to 5 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ed Glick can be reached on (571) 272-2490. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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